PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 14

Total Marks : 45

Max. Time : 54 min.

Topic : Ionic Equilibrium

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.12	(4 marks, 5 min.)	[36, 45]

1. **(a)** Given , $HF + H_2O \xrightarrow{K_a} H_3O^+ + F^-$; $F^- + H_2O \xrightarrow{K_b} HF + OH^-$.
Which relation is correct ?

(A) $K_b = K_w$ (B) $K_b = \frac{1}{K_w}$ (C) $K_a \times K_b = K_w$ (D) $\frac{K_a}{K_b} = K_w$

(b) A 0.0200 M acid is 20% dissociated. The equilibrium constant K_a for the acid is :
(A) 1.6×10^{-3} (B) 10^{-3} (C) 3.6×10^{-3} (D) 1.5×10^{-3}

2. **(a)** What is the K_b of a weak base that can produce one OH^- per molecule if its 0.04 M solution is 2.5% ionized.
(A) 7×10^{-8} (B) 1.6×10^{-6} (C) 2.5×10^{-5} (D) 2×10^{-11}

(b) What is the percent ionization of a 0.01 M HCN solution [$K_a = 6.4 \times 10^{-9}$] .
(A) 0.0025 % (B) 0.08 % (C) 0.25 % (D) 0.8 %

3. **(a)** $HCOOH \rightleftharpoons H^+ + HCOO^-$, $K_a = 1.7 \times 10^{-4}$. Then $[H^+]$ concentration of a solution containing 0.1 M HCOOH & 0.05 M HCOONa is nearly equal to :
(A) 8.5×10^{-5} (B) 3.4×10^{-4} (C) 4.1×10^{-3} (D) 1.8×10^{-2}

(b) pH of 10^{-8} N NaOH is :
(A) 8.0 (B) 6.0 (C) 6.98 (D) 7.02

4. **(a)** K_a for HCN is 5×10^{-10}, calculate K_b for CN^-.

(b) If equilibrium constant of $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$ is 5.55×10^{-10}, calculate equilibrium constant of $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$.

5. **(a)** K_b for trimethylamine is 6.4×10^{-5}. Calculate K_a for trimethyl ammonium ion $(CH_3)_3NH^+$.

(b) For the following equilibrium : $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ equilibrium consatnt is 5.55×10^{-10}. Calculate equilibrium constant for the equilibrium, $NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+$

6. CO_2 in aqueous solution shows following ionic equilibrium : $2H_2O + CO_2 \rightleftharpoons HCO_3^- + H_3O^+$
If hydronium ion (H_3O^+) concentration, is 2×10^{-6} M, what is hydroxide ion (OH^-) concentration ?

7. The degree of dissociation of 0.04 M HA is 0.01 . What would be the degree of dissociation of 0.01 M solution of the acid at the same temperature.

8. Calculate the pH values, assuming complete ionization of :
(a) 5×10^{-4} M monoprotic acid (b) 0.0016 M monoacidic base.

9. The pH of 0.10 M hydrocyanic acid solution is 5. What is the value of K_a for hydrocyanic acid ?

10. K_a of CH_3COOH is 1.8×10^{-5}.Calculate for 0.02 M CH_3COOH :
(i) $[H_3O^+]$, (ii) % ionisation and (iii) pH

REVISION QUESTIONS

11. A mixture of 4 moles of $A_2(g)$ and 1 mole of $XY_2(g)$ initially at a pressure of 1.25 atm at 1400 K is allowed to reach equilibrium, the pressure of the system becomes equal to 1.05 atm. Calculate K_P for the reaction

$$A_2(g) + XY_2(g) \rightleftharpoons A_2Y(g) + A_2X(g).$$

12. The equilibrium concentrations of A, B and C for the reaction $A \rightleftharpoons B + C$ are 4, 2 and 2 mole/litre respectively at 25ºC. If 2 moles per litre of A are removed, calculate the equilibrium concentration of A,B and C at the same temperature.

Answer Key

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1. **(a)** (C) **(b)** (B) **2.** **(a)** (C) **(b)** (B) **3.** **(a)** (B) **(b)** (D)

4. **(a)** $K_b\,[CN^-] = 2 \times 10^{-5}$ **(b)** 1.8×10^{-5}

5. **(a)** $K_a = 1.56 \times 10^{-10}$ **(b)** 1.8×10^{-5} **6.** $[OH^-] = 5 \times 10^{-9}$ M **7.** 0.02.

8. (a) pH = 3.3 (b) pH = 11.2 **9.** 10^{-9}.

10. (i) $[H_3O^+] = 6 \times 10^{-4}$ M (ii) 3% ionised at 0.02 M (iii) 3.22

11. 10. **12.** 2.438 mole/litre ; 1.562 mole/litre ; 1.562 mole/litre.

Hints & Solutions

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11. $3A_2(g) + XY_2(g) \rightleftharpoons 2A_2Y(g) + A_2X(g)$.

$4 - 3x \qquad 1 - x \qquad 2x \qquad x$

$\therefore \quad [n_T = 5 - x]$

$$\frac{4+1}{5-x} = \frac{1.25}{1.05} \Rightarrow x = 0.8 \Rightarrow n_T = 4.2.$$

$$K_P = \frac{\left(\frac{2x}{n_T}P_{eq}\right)^2\left(\frac{x}{n_T}P_{eq}\right)}{\left(\frac{4-3x}{n_T}P_{eq}\right)^3\left(\frac{1-x}{n_T}P_{eq}\right)} = \frac{4x^3}{(4-3x)^3(1-x)} \times \frac{n_T}{P_{eq}} = 10.$$